Anti-Ballistic Materials with High Kinetic Energy Penetrator Shielding and High Wear Resistance

New materials fabricated with boron nitride nanotubes (BNNTs) and BNNT polymer composites

NASA Langley, Jefferson Lab, and the National Institute of Aerospace have jointly developed new materials with greater anti-penetration characteristics. Using BNNTs and BNNT polymer composites, researchers have successfully fabricated the new materials to demonstrate enhanced material toughness and hardness. The presence of boron-10 in the BNNT materials creates an efficient shield against high kinetic energy penetrators and serves as a good radiation shield. In recent years, anti-penetration materials have been increasingly used for armor, bulletproof vests, and micrometeoroid and orbital debris protection layers for space suits, as well as space vehicles and structures. BNNT-based composites possess many advantages over other polymeric, ceramic, or metallic armor materials owing to their light weight, conformability, high toughness, and tailorable properties for use in a variety of applications.

Benefits

- High kinetic energy penetrator shielding (attributed to the presence of boron-10)
- Radiation protection and shielding
- Flexible and lightweight
- High transparency in optical wavelength
- High wear resistance – extended service life under harsh abrasive conditions
- High thermal stability (> 800ºC)
- Expanded astronaut and equipment safety during Extra Vehicular Activities (EVAs), a factor of growing importance with the increase in EVA duration and complexity

partnership opportunity

The Technology Gateway

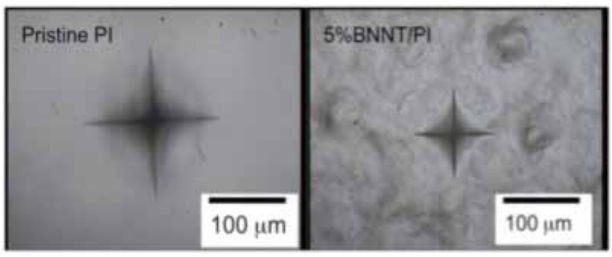
Applications

- Strong, lightweight structural materials for anti-micrometeorite/anti-micrometeoroid layers for spacecrafts
- Ultra strong tethers
- Space Extravehicular Mobility Units, including space suits
- Armor for the human body or military vehicles, military helmets, and safety suits/helmets for industrial use
- Transparent protection plates, including high-impact-resistant goggles/visors and transparent armor plates (materials are transparent in optical wavelength)
- High temperature wear protection applications near engine and exhaust parts of aerospace vehicles

The Technology

To maximize the ability of anti-penetration materials to protect against high kinetic energy penetrators, the following two material properties should be considered: high hardness for rebounding of the penetrator and/or for gross mechanical deformation of the penetrator, and high toughness for effective energy absorption during the mechanical deformation (and heat) of the protecting materials.

To increase both the hardness and toughness, BNNTs, boron nitride nanoparticles (BNNPs), carbon nanotubes (CNTs), graphites, or their combinations can be incorporated into matrices of polymer, ceramic, or metals. Fibers, yarns, and woven or nonwoven mats of BNNTs are used as toughening layers to maximize energy absorption and/or high hardness layers to rebound or deform penetrators. They can also be used as reinforcing inclusions, combining with other polymer matrices to create reinforcing composite layers to maximize anti-penetrator protection. In addition, enhanced wear resistance can be expected by adding boron nitride nanomaterials because of the increase in hardness and toughness.



Microindentation test of BNNT composite

For More Information

If your company is interested in licensing or joint development opportunities associated with this technology, or if you would like additional information on partnering, please contact:

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